

Relicensing Study 3.3.10

Assess Operational Impacts on Emergence of State-Listed Odonates in the Connecticut River

Interim Study Report

**Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)**

Prepared for:



Prepared by:



APRIL 2015

TABLE OF CONTENTS

1	INTRODUCTION.....	1-1
1.1	Study Goals and Objectives	1-2
2	STUDY SITES AND METHODS.....	2-1
2.1	Study Sites	2-1
2.2	Methods	2-1
3	RESULTS.....	3-1
3.1	Odonate Survey Results	3-1
3.1.1	Species Assemblage.....	3-1
3.1.2	Emergence and Eclosure.....	3-1
3.2	Habitat Characterization	3-1
4	NEXT STEPS	4-1
4.1	Review Existing Information.....	4-1
4.2	Quantitative Emergence and Eclosure Surveys	4-1
4.3	Emergence and Eclosure Speed	4-2
4.4	Water Fluctuation Impact Assessment	4-3

LIST OF TABLES

Table 2.1-1: Locations, dates, and level of effort for each of the eight odonate survey sites in the Connecticut River.	2-2
Table 3.1.1-1: Odonate species documented during the qualitative surveys of larvae and exuviae in June 2014.....	3-1
Table 3.1.2-1: Summary of distance traveled (height above water and distance from the edge of the water) and eclosure substrate for exuviae collected in June 2014.	3-3
Table 3.2-1: Summary of habitat parameters recorded for each survey site.	3-4

LIST OF FIGURES

Figure 2.1-1 Index: Study Sites.....	2-3
Figure 2.1-1a: Study Sites.....	2-4
Figure 2.1-1b: Study Sites	2-5
Figure 2.1-1c: Study Sites.....	2-6
Figure 2.1-1d: Study Sites	2-7
Figure 2.1-1e: Study Sites.....	2-8

LIST OF APPENDICES

APPENDIX A – PHOTOGRAPHS

LIST OF ABBREVIATIONS

FERC	Federal Energy Regulatory Commission
FirstLight	FirstLight Hydro Generating Company
ft	feet
hrs	hours
ILP	Integrated Licensing Process
m	meter
NHESP	Natural Heritage and Endangered Species Program
PAD	Pre-Application Document
PSP	Proposed Study Plan
RSP	Revised Study Plan
SD1	Scoping Document 1
SD2	Scoping Document 2
SPDL	Study Plan Determination Letter
VY	Vermont Yankee Nuclear Power Plant

1 INTRODUCTION

FirstLight Hydro Generating Company (FirstLight), a subsidiary of GDF SUEZ North America, Inc., is the current licensee of the Northfield Mountain Pumped Storage Project (Northfield Mountain Project, FERC No. 2485) and the Turners Falls Hydroelectric Project (Turners Falls Project, FERC No. 1889). FirstLight has initiated with the Federal Energy Regulatory Commission (FERC, the Commission) the process of relicensing the Northfield Mountain and Turners Falls Projects using the FERC's Integrated Licensing Process (ILP). The current licenses for Northfield Mountain and Turners Falls Projects were issued on May 14, 1968 and May 5, 1980, respectively, with both set to expire on April 30, 2018.

As part of the ILP, FERC conducted a public scoping process during which various resource issues were identified. On October 31, 2012, FirstLight filed its Pre-Application Document (PAD) and Notice of Intent with the FERC. The PAD included FirstLight's preliminary list of proposed studies. On December 21, 2012, FERC issued Scoping Document 1 (SD1) and preliminarily identified resource issues and concerns. On January 30 and 31, 2013, FERC held scoping meetings for the Northfield Mountain and Turners Falls Projects. FERC issued Scoping Document 2 (SD2) on April 15, 2013.

FirstLight filed its Proposed Study Plan (PSP) on April 15, 2013 and, per the Commission regulations, held a PSP meeting at the Northfield Visitors Center on May 14, 2013. Thereafter, FirstLight held ten resource-specific study plan meetings to allow for more detailed discussions on each PSP and on studies not being proposed¹. On June 28, 2013, FirstLight filed with the Commission an Updated PSP to reflect further changes to the PSP based on comments received at the meetings. On or before July 15, 2013, stakeholders filed written comments on the Updated PSP. FirstLight filed a Revised Study Plan (RSP) on August 14, 2013 with FERC addressing stakeholder comments.

On August 27, 2013 Entergy Corp. announced that the Vermont Yankee Nuclear Power Plant (VY), located on the downstream end of the Vernon Impoundment on the Connecticut River and upstream of the two Projects, will close at the end of 2014. With the closure of VY, certain environmental baseline conditions will change during the relicensing study period. On September 13, 2013, FERC issued its first Study Plan Determination Letter (SPDL) in which many of the studies were approved or approved with FERC modification. However, due to the impending closure of VY, FERC did not act on 19 proposed or requested studies pertaining to aquatic resources. RSP Study No. 3.3.10 *Assess Operational Impacts on Emergence of State-Listed Odonates in the Connecticut River*, was one of the studies that FERC did not act upon. The SPDL for these 19 studies was deferred until after FERC held a technical meeting with stakeholders on November 25, 2013 regarding any necessary adjustments to the proposed and requested study designs and/or schedules due to the impending VY closure. FERC issued its second SPDL on the remaining 19 studies, including this study, on February 21, 2014, approving the RSP with certain modifications. Those modifications included:

- Relative to emergence speed, FERC recommended that FirstLight record a minimum of 10 observations per species or species group, provided that 10 individuals from each group are encountered during the emergence study.
- Relative to quantitative survey effort, FERC recommended that FirstLight stratify the survey effort (Surveys of Emergence/Eclosure Behavior), to a minimum of six 2-meter transects in each *available* habitat in each study reach.

This interim report presents the results of the qualitative surveys conducted under Task 3 of Study No. 3.3.10.

¹ The ten meetings were held on May 14, 15, 21, and 22, and June 4, 5, 11, 12, and 14 and August 8.

1.1 Study Goals and Objectives

This study was designed to provide information on the effects of project operations, especially the timing, rate, and magnitude of water level changes, on emerging dragonflies (Insecta: Odonata) in the Connecticut River. This study had two objectives:

1. Synthesis of existing data, supplemented with field surveys, to characterize the assemblage structure and emergence/eclosure behavior of odonates in the project area.
2. Determine if project operations affect the emergence and eclosure success of state-listed odonates, and the potential implications for the odonate assemblage in affected areas.

Two phases of fieldwork were proposed. Phase 1, completed in 2014 and summarized in this interim report, included qualitative surveys of odonate larvae and exuviae at selected sites to determine assemblage structure and to collect basic habitat data. Phase 2, planned for 2015, will include quantitative surveys and observations of emergence/eclosure behavior of odonates to provide data for analyses of the effects of project operations on odonates and their habitat. Phase 2 methods were not finalized in the Revised Study Plan, rather, these details were to be discussed in this interim report and finalized before the 2015 field season commences, in consultation with the Massachusetts Natural Heritage and Endangered Species Program (NHESP).

2 STUDY SITES AND METHODS

Preceding the qualitative field surveys, a scientific collection permit was issued by the NHESP on May 15, 2014.

2.1 Study Sites

Biodiversity biologists conducted qualitative surveys of odonate larvae and exuviae at four areas (5 sites) between the Turners Falls Dam and the Route 116 Bridge in Sunderland, and one area (3 sites) in the Turners Falls Impoundment near Barton Cove ([Figure 2.1-1](#), [Table 2.1-1](#)). Surveys were conducted on June 2, 6, 9, and 20 (2014). Barton Cove and the Route 116 Bridge were also checked twice in May to determine if emergence had begun early. However, the spring of 2014 was cooler than average and river flows were higher than average, and emergence was not detected until early June.

- Representative aquatic and shoreline habitats were surveyed in Barton Cove and on the other side of Campground Point, totaling approximately 350 meters of shoreline ([Figure 2.1-1a](#)).
- Representative aquatic and shoreline habitats were surveyed in Turners Falls Project's bypass reach. These surveys were mostly conducted in a ~500 meter reach upstream and downstream from Rock Dam, a natural rock formation with a vertical drop ([Figure 2.1-1b](#)).
- Representative aquatic and shoreline habitats were surveyed within two reaches in the area between the Railroad Bridge and Third Island (Montague/Deerfield), totaling approximately 400 meters of shoreline ([Figure 2.1-1c](#)). In addition, approximately 150 meters of aquatic and shoreline habitat near the Route 116 Bridge in Sunderland were surveyed in a similar manner ([Figure 2.1-1d](#)).

2.2 Methods

Collection methods for larvae included aquatic D-nets and hand picking odonates in the water or on land. Collections were made while wading, snorkeling, and while walking along the riverbank. If present, teneral or exuviae were collected on the riverbank. For teneral or exuvia, biologists recorded the vertical and lateral distance from the water's edge, and surface that each was collected on. At each site, aquatic, riparian, and upland habitat parameters were recorded or photographed ([Appendix A](#)):

- **Aquatic Parameters:** water depth, water velocity, dominant substrate types, presence and coverage of aquatic vegetation and organic material;
- **Riparian/Upland Parameters:** bank slope, bank height, bank stability, riparian vegetation, tree canopy height and density, land use/land cover.

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)
 ASSESS OPERATIONAL IMPACTS ON EMERGENCE OF STATE-LISTED ODONATES IN THE CONNECTICUT RIVER

Table 2.1-1: Locations, dates, and level of effort for each of the eight odonate survey sites in the Connecticut River.

Site	Area	Town	Survey 1	Survey 2	Total Survey Duration (hrs)	Total Linear Survey Distance (m)
1	Barton Cove	Gill	6/2/2014	6/20/2014	3	200
2	Barton Cove	Gill	6/2/2014	-	1	50
3	Barton Cove	Gill	6/2/2014	6/20/2014	2	100
4	Bypass Reach - Rock Dam	Montague	6/6/2014	6/20/2014	6	500
5	Downstream from Railroad Bridge	Montague	6/9/2014	-	3	150
6	Between Railroad Bridge and Third Island	Deerfield	6/9/2014	-	1.5	50
7	Upstream from Third Island	Deerfield	6/9/2014	-	3	200
8	Route 116 Bridge, Boat Ramp	Sunderland	6/20/2014	-	2	150



**Northfield Mountain Pumped Storage Project (no. 2485)
and Turners Falls Hydroelectric Project (No. 1889)**

RELICENSING STUDY 3.3.10
Assess Operational Impacts on Emergence of
State-listed Odonates in the Connecticut River



Figure 2.1-1 Index. Study Sites

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA,

Copyright © 2015 FirstLight Power Resources All rights reserved.



Legend
Survey Sites



**Northfield Mountain Pumped Storage Project (no. 2485)
and Turners Falls Hydroelectric Project (No. 1889)**

RELICENSING STUDY 3.3.10

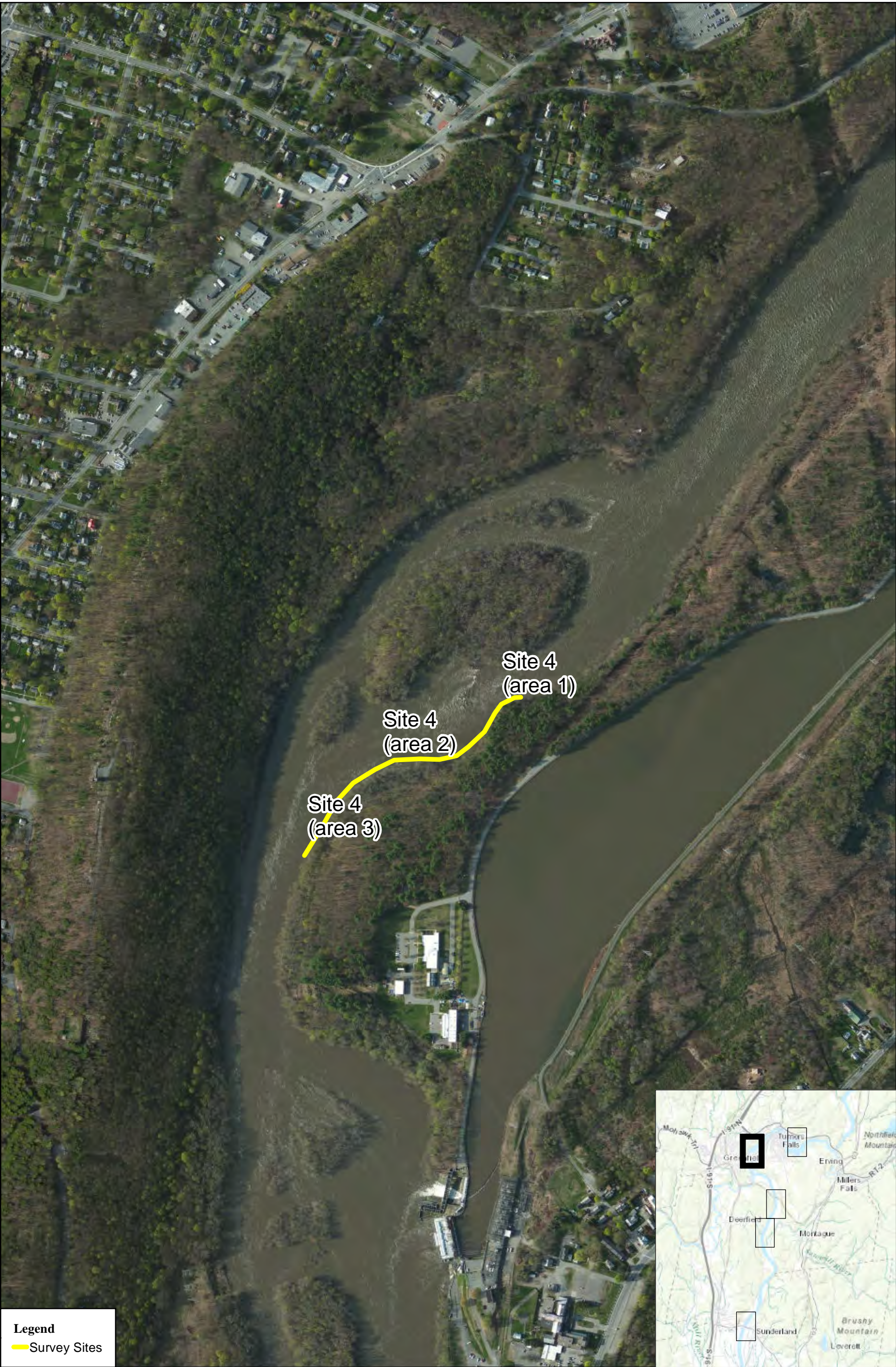
Assess Operational Impacts on Emergence of
State-listed Odonates in the Connecticut River

0 0.05 0.1 0.2
Miles

Figure 2.1-1a. Study Sites

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA,

Copyright © 2015 FirstLight Power Resources All rights reserved.



Legend
— Survey Sites



**Northfield Mountain Pumped Storage Project (no. 2485)
and Turners Falls Hydroelectric Project (No. 1889)**

RELICENSING STUDY 3.3.10

Assess Operational Impacts on Emergence of
State-listed Odonates in the Connecticut River

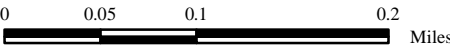


Figure 2.1-1b. Study Sites

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA,

Copyright © 2015 FirstLight Power Resources All rights reserved.



Legend
Survey Sites



**Northfield Mountain Pumped Storage Project (no. 2485)
and Turners Falls Hydroelectric Project (No. 1889)**

RELICENSING STUDY 3.3.10

Assess Operational Impacts on Emergence of
State-listed Odonates in the Connecticut River

0 0.05 0.1 0.2
Miles

Figure 2.1-1c. Study Sites

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA,

Copyright © 2015 FirstLight Power Resources All rights reserved.



Legend
— Survey Sites



**Northfield Mountain Pumped Storage Project (no. 2485)
and Turners Falls Hydroelectric Project (No. 1889)**

RELICENSING STUDY 3.3.10

Assess Operational Impacts on Emergence of
State-listed Odonates in the Connecticut River



Figure 2.1-1d. Study Sites

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA,

Copyright © 2015 FirstLight Power Resources All rights reserved.



Legend
— Survey Sites



**Northfield Mountain Pumped Storage Project (no. 2485)
and Turners Falls Hydroelectric Project (No. 1889)**

RELICENSING STUDY 3.3.10

Assess Operational Impacts on Emergence of
State-listed Odonates in the Connecticut River



Figure 2.1-1e. Study Sites

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA,

Copyright © 2015 FirstLight Power Resources All rights reserved.

3 RESULTS

3.1 Odonate Survey Results

3.1.1 Species Assemblage

[Table 3.1.1-1](#) lists the genera and species collected at each site. *Epithea princeps*, a species common in lentic habitats, was the most common species collected at Sites 1-3. These sites in the lowermost portion of the Turners Falls Impoundment (Barton Cove) contain mostly lentic habitat with submerged and emergent vegetation. Sites 4-8 were generally more lotic; dominant taxa in these samples included *Gomphus* sp. (mostly *G. vastus*), *Ophiogomphus* (mostly *G. rupinsulensis*), *N. yamaskenensis*, *Boyeria vinosa*, and *Macromia illinoensis*. There was very little variation in the odonate assemblage among sites 4-8. Species-level identification of some of the Gomphidae, especially *Gomphus* sp. and *Ophiogomphus* sp., is incomplete; this interim report will be updated when these data become available. Most of the target state-listed species for Sites 4-8 were in the genus *Gomphus*. Based on historic survey data, which were generally more complete for the Turners Falls Impoundment, several uncommon species likely occur in these areas but were undetected in 2014.

Table 3.1.1-1: Odonate species documented during the qualitative surveys of larvae and exuviae in June 2014.

Species	Survey Site							
	1	2	3	4	5	6	7	8
<i>Arigomphus furcifer</i>		X						
<i>Boyeria vinosa</i>	X			X	X	X	X	X
<i>Epithea princeps</i>	X	X	X	X	X			
<i>Gomphus</i> sp.*			X	X	X	X	X	X
<i>Macromia illinoensis</i>	X	X	X	X	X	X	X	X
<i>Neurocordulia yamaskenensis</i>	X	X	X	X	X	X	X	X
<i>Ophiogomphus</i> sp*				X	X	X	X	X
<i>Stylurus spiniceps</i>				X				

*Awaiting final species-level identification by Dr. David Wagner, University of Connecticut. Potential Species: *Gomphus fraternus*, *Gomphus ventricosus*, *Gomphus abbreviates*, *Gomphus vastus*, *Dromogomphus spinosus*, *Ophiogomphus rupinsulensis*, *Gomphus spicatus*, *Gomphus exilis*, *Gomphus descriptus*, *Gomphus lividus*

3.1.2 Emergence and Eclosure

Approximately 250 exuviae were collected across the eight survey sites. These were found on emergent aquatic vegetation only at sites 1 and 3, as this type of emergence substrate was not available at the other sites. Elsewhere, exuviae were found primarily on terrestrial herbaceous vegetation, soil, trees, coarse fallen wood, and rock ([Table 3.1.2-1](#)). They were found as high as nine feet above the water's surface (mean = 4.4) and as far as 42 feet from the edge of the water (mean = 12.7). Since these surveys were qualitative and only occurred during the month of June, these distances above the water and from the water's edge are biased, but do provide a range to consider in the next phase of work.

3.2 Habitat Characterization

Habitat parameters recorded at each site are provided in [Table 3.2-1](#), and representative photographs are provided in [Appendix A](#). The most common habitat feature of nearshore areas and streambanks was a

ASSESS OPERATIONAL IMPACTS ON EMERGENCE OF STATE-LISTED ODONATES IN THE
CONNECTICUT RIVER

muddy slope of varying steepness, with lesser and variable amounts of sand, gravel, or cobble. Upslope, this mud transitioned into the riparian zone that was typically vegetated with trees (especially silver maple), low terrestrial herbaceous vegetation, moss, and vines, and contained varying amounts of large woody debris and detritus. The odonate surveys were typically done during periods of low flow, therefore relatively large amounts of the muddy bank were exposed and the distance from the water line to the interface between aquatic and terrestrial habitat was relatively great.

Less common nearshore habitat types included aquatic emergent vegetation and rock. Aquatic emergent vegetation was prevalent only in the more lentic habitats of Barton Cove (Site 1) and on the other side of Campground Point (Site 3). Elsewhere, aquatic emergent vegetation was either absent, or existed as a very sparse fringe of species that can tolerate daily exposure. Submerged aquatic vegetation, especially *Vallisneria*, was common in some areas but typically only as a narrow band in deeper waters.

Bare rock, an emergence substrate for odonates, is uncommon in the Connecticut River between the Deerfield River confluence and Route 116 Bridge. There are some isolated ledge outcrops, and the bridge abutments and areas near bridges often contained higher amounts of “unnatural” rock. The most “natural” rock is located in the Turners Falls bypass reach.

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)
 ASSESS OPERATIONAL IMPACTS ON EMERGENCE OF STATE-LISTED ODONATES IN THE CONNECTICUT RIVER

Table 3.1.2-1: Summary of distance traveled (height above water and distance from the edge of the water) and eclosure substrate for exuviae collected in June 2014.

Parameter	Survey Site*							
	1	3	4	5**	6	7	8	Total
Sample Size	28	-	37	53	50	79	-	247
Vertical Height from Waters Surface (ft)								
Mean	1.5	-	4.1	5.1	5.4	4.1	-	4.4
Minimum	0.5	0.0	0.3	0.5	1.5	2.0	4.0	0
Maximum	3.0	3.0	7.0	9.0	8.5	8.0	8.0	9
Lateral Distance from Waters Edge (ft)								
Mean	14.0	-	13.8	17.8	5.8	7.9	-	12.7
Minimum	0.0	0.0	2.0	0.0	0.0	5.5	10.0	0
Maximum	15.0	3.0	23.0	42.0	8.0	20.0	25.0	42
Eclosure Substrate								
Aquatic Emergent Vegetation	25	X	0	0	0	0	0	25
Terrestrial Herbaceous Vegetation	0	0	23	10	18	48	X	99
Tree	0	0	4	33	0	3	X	40
Coarse Fallen Wood	3	X	3	2	1	2	X	11
Soil	0	0	6	7	31	25	X	69
Rock	0	0	1	1	0	1	X	3

*These data were not collected at Site 2.

**At least 200 more exuviae found at Site 5. Mostly 2-8 ft above water's surface and 4-7 ft from waters edge. Found mostly on low herbaceous vegetation and trees.

- Ranges and cursory descriptions were recorded at Site 3 and Site 8, thus sample size and means were not calculated.

X indicates that exuviae were found on that specific habitat type, 0 indicates that it was not. The reason X is used for Site 3 and Site 8 is because exuviae were not quantified at those two sites.

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)
 ASSESS OPERATIONAL IMPACTS ON EMERGENCE OF STATE-LISTED ODONATES IN THE CONNECTICUT RIVER

Table 3.2-1: Summary of habitat parameters recorded for each survey site.

Parameter	Survey Site							
	1	2	3	4	5	6	7	8
Aquatic Habitat								
Max Depth Surveyed (ft)	2.0	2.5	2.5	4.0	2.5	2.5	4.0	4.0
Flow Velocity¹	None	None	None	Light to Fast	Light to Moderate	Moderate to Fast	Light to Moderate	Moderate
Substrate (%)²								
SILT	50	10	80	20	40	15	25	20
SAND	45	0	5	20	30	15	15	20
GRAV	0	40	5	20	20	40	25	30
COBB	5	50	10	35	10	30	35	30
BEDR	0	0	0	5	0	0	0	0
Cover³								
%VEG	25	<5	10	<5	<5	10	<5	10
%FPOM	50	<5	75	5	20	<5	10	<5
%CPOM	10	<5	<5	10	20	<5	20	10
Aquatic Habitat Notes	Lentic habitat with littoral zone. Emergent vegetation common.	Lentic habitat, lacking littoral vegetation at time of survey.	Lentic habitat with narrow littoral zone. Emergent vegetation sparse at time of survey.	Mostly lotic-erosional habitat with nearshore depositional areas, subject to wide fluctuations.	Slow-flowing lotic habitat, sparse submerged and emergent vegetation, mostly fine substrates and detritus.	Lotic erosional; faster flows compared to nearby areas, but still with depositional areas near shoreline.	Steep muddy banks with one gravel/cobble point bar where small stream enters.	Variable conditions; rocky under bridge, gravelly near boat ramp, silt/mud along portions of shoreline.

Notes:

1. Qualitative, based on visual observations focused on the area within 30 meters of the shoreline.
2. Approximate percent cover of each substrate type throughout the site, recognizing significant small-scale variability. GRAV = gravel, COBB = Cobble, BEDR = bedrock.
3. Approximate percent cover of elements that provide cover, including submerged or emergent vegetation (VEG), detritus and fine particulate organic matter (FPOM), and woody debris/coarse particulate organic matter (CPOM)

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)
 ASSESS OPERATIONAL IMPACTS ON EMERGENCE OF STATE-LISTED ODONATES IN THE CONNECTICUT RIVER

Table 3.2-1: Summary of habitat parameters recorded for each survey site (continued).

Parameter	Survey Site							
	1	2	3	4	5	6	7	8
Riparian/Upland Habitat								
Bank Slope⁴	Very Gradual	Gradual	Moderate	Moderate to Vertical	Gradual to Moderate	Moderate to Steep	Moderate to Steep	Moderate to Steep
Bank Height⁵	-	2.0-3.0 ft	2.0-3.0 ft	Variable; to 10 ft	Variable; to 10 ft	Variable; to 12 ft	Variable; to 12 ft	Variable; to 15 ft
Bank Stability⁶	1	1	1	1-2	1	2-3	1-2	1-3
Land Use/Cover	Forest, Road	Forest	Forest	Forest	Forest, Cropland, Residential	Cropland, Forest, Residential	Cropland, Forest	Forest, Residential, Road
Riparian / Upland Habitat Notes	-	-	-	Some gradually sloping banks with floodplain forest upland, some steep bedrock outcrops and vertical rocky banks.	Mud/sand streambanks with overhanging silver maple. Agricultural land beyond narrow riparian buffer.	Riparian strip of herbaceous and shrub species plus floodplain tree species. Some degree of bank instability.	Herbaceous lower bank, with silver maple floodplain forest higher. A lot of large woody debris.	Boat launch, bridge abutments, and upland development characterize this area.

Notes:

4. Qualitative. Biologists took representative photographs ([Appendix A](#)) to document nearshore and riparian habitats.
5. Qualitative. In practice, bank height was variable and difficult to measure, especially where there was a gradual transition from exposed riverbed to the toe and top of the bank. Photographs are likely more informative than these simple descriptors.
6. Informal, qualitative scoring: 1 = Stable, 2 = Moderately Stable, 3 = Moderately Unstable, 4 = Unstable

4 NEXT STEPS

4.1 Review Existing Information

Information on the odonate assemblage in the project-affected reaches of the Connecticut River will be gathered from publications, reports, and relevant case studies. Experts who were involved with the dragonfly studies in the Turners Falls Impoundment in the 2000s have been contacted to provide expert opinion and in some cases unpublished data. The life history and ecology, and particularly emergence and eclosure behavior, of these species and species groups will be summarized in the final report.

4.2 Quantitative Emergence and Eclosure Surveys

Prior to the 2015 quantitative fieldwork, another scientific collection permit will be obtained from the Massachusetts NHESP.

FirstLight proposes to conduct quantitative surveys at three sites, including one in the Turners Falls Impoundment, one in the Turner Falls bypass reach near Rock Dam, and one in the Connecticut River below Cabot Station. The Revised Study Plan specified that the quantitative surveys would be conducted at four reaches. However, upon review of odonate data collected from 2001 to 2010 in the Turners Falls Impoundment, FirstLight believes that these studies provided ample data to meet the study objectives for all areas except Barton Cove, which was underrepresented in those studies. FirstLight will consult with NHESP on site locations but proposes the following three sites based on habitat diversity and accessibility: (1) Barton Cove/Campground Point, (2) Site 4 (Rock Dam) from this interim report, and (3) Site 8 (Route 116 Bridge) from this interim report.

Larvae may exit the water on a limited number of surfaces, such as emergent aquatic vegetation, sloped banks comprised of fine to coarse soils (e.g., mud, sand, gravel, cobble), or large rock (natural boulder or ledges, or unnatural riprap). Some larvae will stop to eclose on these surfaces, or travel farther upslope to eclose on herbaceous terrestrial vegetation, tree roots, or tree trunks. FirstLight proposes to establish transects perpendicular to the river that span the entire continuum from the water's edge into the upland terrestrial vegetation, and then determine where different species eclose along that continuum. Transects will be monumented with PVC pipe or rebar along their length. Each transect will be three meters wide, and will extend upslope from the water's edge approximately 12 meters. FirstLight has proposed increasing the transect width from what was proposed in the Revised Study Plan from 2 to 3 meters, or from 24m² to 36m², to increase the number of microhabitats and exuviae that occur within transects. Based on 2014 observations, it is likely that more than 100 (and possibly 300-500) exuviae will be collected per transect, per visit, during periods of peak emergence.

FERC's SPDL stated that the survey effort should be stratified in each reach to provide adequate replication of each habitat type (natural vegetation, gradually sloping mud/sand, and rock). Based on habitat characterization in 2014, some habitat types stated as being important in the SPDL were uncommon and it may not be necessary to sample these to accomplish overall objectives of this study. For example, emergent aquatic vegetation is very sparse in both the bypass reach and below Cabot Station. Barton Cove and Campground Point contain significant amounts of emergent aquatic vegetation along with other emergence habitats. More than 95 percent of the shoreline of the Connecticut River between the Deerfield River confluence and Route 116 Bridge is comprised of muddy/sandy slopes with low and variable amounts of embedded gravel and cobble, transitioning to roots and trunks of floodplain trees (especially silver maple), terrestrial herbaceous vegetation, and vines. This type of habitat is also prevalent in the bypass reach, although natural ledge outcroppings and cobble shorelines are more common. Based on habitat availability at each of the proposed survey sites, and the fact that every transect spans a continuum from the water's edge into adjacent uplands as far as odonates have been

ASSESS OPERATIONAL IMPACTS ON EMERGENCE OF STATE-LISTED ODONATES IN THE
CONNECTICUT RIVER

documented to travel, FirstLight contends that the following replication (3 sites, 26 transects) is adequate to meet the objectives of the survey:

- Site 1 (Barton Cove/Campground Point): 9 transects (3 starting in emergent aquatic vegetation, 3 starting in ledge outcrop, and 3 starting in mud/sand/gravel).
- Site 2 (Site 4 from this interim report): 9 transects (3 starting in ledge outcrop, 3 starting in gravel/cobble, 3 starting in mud/sand) [there is no emergent aquatic vegetation at this site]
- Site 3 (Site 8 from this interim report): 8 transects (4 starting in gravel/cobble, 4 starting in mud/sand) [there is no ledge outcrop or emergent aquatic vegetation at this site]

The SPDL recommended a minimum of six 2-meter transects in each available habitat type (natural vegetation, gradual sloping mud/sand banks, and rock substrate) in each study reach. This effort could yield up to a potential of 72 2-meter transects per survey date or approximately 475 feet of the river bank. Our proposal would result in three to four transects per site (26 transects total), each transect being 3 meters wide. This proposed effort would survey approximately 256 feet of the river bank.

The following habitat data will be collected at each transect: GPS location of both ends, slope, elevation of the upslope and water ends, elevation of the mean high water mark, types and percent cover of each substrate type, substrate embeddedness, species composition and percent cover of aquatic and upland plants, and anything else noteworthy about conditions at each transect. All transects will be photo-documented.

Surveys for emerging larvae, exuviae, and teneral adults will be conducted at each transect every two weeks from mid-May through late August, and will be timed to coincide with weather (warm air temperatures, dry and sunny days) and flow conditions (average to below-average flows, based on USGS streamflow data at the Montague City gage (01170500)) that are conducive to emergence, and during times that are generally considered peak emergence periods for target species that occur in these areas. Surveys will be conducted on weekday mornings when recreational use of the river is low. If possible, surveys will be coordinated with upstream hydropower operations to occur during a period of stable water levels to increase likelihood of collecting data on species that emerge very near the water line and might otherwise be washed away by daily flow fluctuations, and for similar reasons, will not be conducted within two days of heavy rainfall that might dislodge and wash away exuviae.

The time of day, weather, water level, and a qualitative assessment of boat traffic will be recorded at the time of each survey. For each exuvia and teneral, the vertical height above the water's surface, the horizontal distance from the water's edge, and its eclosion structure/substrate will be recorded. Each exuvia will be collected, stored in individual vials, labeled with site information and date, and preserved for later species identification.

4.3 Emergence and Eclosion Speed

Emerging larvae will be watched/tracked as they progress upslope, and the time it takes for them to stop, eclose, and fly away will be recorded. This is a time-intensive observation process that relies on seeing larvae before they stop and begin to eclose. Based on cursory observations in 2014 and discussions with other experts who have attempted these types of observations, it is feasible to accomplish this task for relatively common species (e.g., *G. vastus*, *N. yamaskanensis*, *S. spiniceps*, *M. illinoensis*, *O. rupinsulensis*, *E. princeps*). However, it may not be possible to observe some rare species that may be outnumbered by common species by at least 1000:1 (e.g., *G. fraternus*, *G. ventricosus*, *G. abbreviatus*, *S. amnicola*). FirstLight concurs with FERC's SPDL that stated, "We recommend FirstLight record a minimum of 10 observations per species or species group, provided that 10 individuals from each group are encountered during the emergence surveys."

ASSESS OPERATIONAL IMPACTS ON EMERGENCE OF STATE-LISTED ODONATES IN THE
CONNECTICUT RIVER

Observations will coincide with the quantitative exuvia surveys. Biologists will look for larvae exiting the water or crawling on land, and will focus on single individuals as they crawl upslope and come to rest to begin the eclosure process. The most critical period is the time from when larvae begin to eclose and when the teneral's wings have hardened and the adult flies away. Biologists will use a stopwatch to record the duration of this process, and photograph the teneral to help verify species-level identification. For each exuvia, the vertical height above the water's surface, the horizontal distance from the water's edge, and its eclosure structure/substrate will be recorded. Each exuvia will be collected, stored in individual vials, labeled with site information and date, and identified to species in the laboratory.

4.4 Water Fluctuation Impact Assessment

FirstLight will deploy a water level logger (with the capability to record temperature) set to record data at 15-minute intervals in each quantitative survey reach to accurately evaluate water levels, standardize field measurements, and describe temperature in relation to odonate emergence behavior. The loggers will be installed approximately mid-May, and remain in place for the duration of the survey.

In addition, hydraulic models, that have been developed for the whole study area independent of the odonate study, will be used to determine if water level fluctuations affect the emergence and eclosure success of state-listed odonates. The timing (i.e., when species emerge), distance travelled (both horizontal and vertical), and duration (i.e., speed) of eclosure for species and/or species groups will be used in concert with the hydraulic model to determine if, how, and when they are most vulnerable to fluctuating water levels.

APPENDIX A – PHOTOGRAPHS



Site 1: Barton's Cove



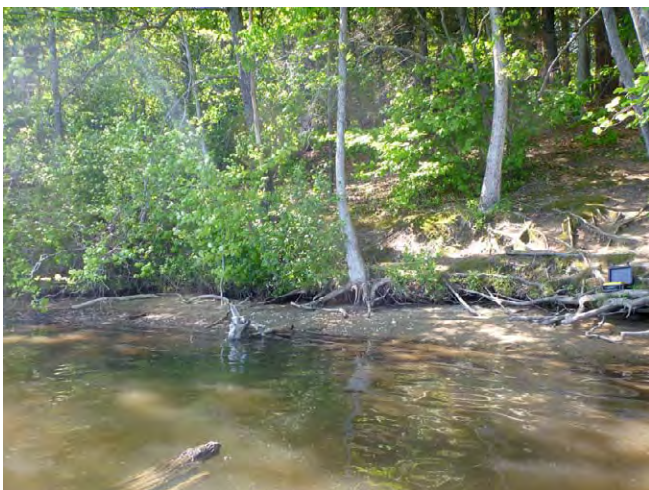
Site 1: Barton's Cove



Site 2: Barton's Cove



Site 2: Barton's Cove



Site 3: Campground Point



Site 3: Campground Point



Site 4: Bypass Reach



Site 4: Bypass Reach



Site 4: Bypass Reach



Site 4: Bypass Reach



Site 4: Bypass Reach



Site 5: Downstream of RR Bridge



Site 5: Downstream of RR Bridge



Site 6: Between RR Bridge and Third Island



Site 6: Between RR Bridge and Third Island



Site 7: Near Third Island



Site 7: Near Third Island



Site 7: Near Third Island



Site 7: Near Third Island



Site 8: Near Route 116 Bridge



Site 8: Near Route 116 Bridge



Site 8: Near Route 116 Bridge